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Microgravity Sciences Onboard the International Space Station and Beyond - Part 1 (6)

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ADVANCED HEAT PIPES PAYLOAD FOR EXPERIMENTS ON BOARD THE INTERNATIONAL SPACE STATION.

Abstract

The International Space Station was mainly thought as an orbiting research laboratory and, as such, it comprises several resources to test and validate new technologies to be used in future space missions. This paper presents ARTE (Advanced Research for passive Thermal Exchange), a microgravity experiment to be flown on the ISS, featuring the test of advanced heat pipes for thermal control of future spacecraft, both manned and unmanned. Tendency for future space systems points towards simplicity, limited maintenance needs and high reliability. In particular, vehicle thermal control should be based on passive systems, requiring low maintenance and very limited remote control. Accordingly, heat-pipes are good candidates for future spacecraft thermal control, due to their low complexity and maintenance requirement, as well as their high reliability. In this scenario, ARTE aims at the development of a payload for the demonstration, in microgravity conditions, of Heat Pipes and low toxicity working fluids, which would make it compatible with human applications (habitable modules) as well. The flight payload consists of four Heat Pipes, as different working fluids are to be tested. Each heat pipe has an electrical resistance at one end (heater), to simulate typical heat produced by avionic systems on-board the ISS. The other extremity is connected to a cold source (cooler). The payload will be integrated in one of the ISS payload rack, providing the necessary resources to operate the experiment. This paper first provides a general description of ARTE concept and project schedule, including the operations to be carried out on the ISS. Then, it focuses on the development of the payload flight model. This includes the assessment of the requirements, the configuration of system architecture, and all preliminary analyses involved in the process. These research analyses refer to the comparison of different working fluids respect to several factors: chemical and physical properties of pure fluids and mixtures, operating limits, toxicity, compatibility with heat pipes material, and of course operational behaviour with different capillary structures and sizes. The results

are completed, when needed, by relevant numerical simulations and experimental results.